REMARKS

Claims 39, 45, 46, 47, 48, 50 and 51 are amended. Claim 40 is cancelled. Claims 39, 41 and 44-52 are pending in the application.

Claims 48 and 52 stand rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains to make or use the invention. The Examiner states that the recited "reducing the theoretical decomposition rate to a lower actual decomposition rate" by addition of H_2O or H_2O_2 is not enabled because "the organic silicon precursor is not in equilibrium with the at least one of H_2O or H_2O_2" and because "there is no reverse reaction so an equilibrium cannot exist," (Action page 3, section 3). The Examiner bases these statements on applicant's admitted prior art reference IslamRaja et al., which at page 722 sets forth uni-directional representations of proposed surface reactions. Applicant notes that the reaction paths set forth by IslamRaja are <u>model</u> reactions, as specifically noted by IslamRaja in the article's title and in the article's text at, for example, page 723, first paragraph, lines 1-3. Applicant further notes that IslamRaja sets forth one of a number of very different models that have been proposed for silicon oxide deposition from TEOS.

Applicant respectfully directs the Examiner's attention to an article enclosed herewith entitled "Chemical Kinetics in Chemical Vapor Deposition: Growth of Silicon Dioxide from Tetraethoxysilane (TEOS)", by Michael E. Coltrin et al.; Thin Solid Films 365 (2000), pages 251-263. Applicant has provided the Coltrin article to demonstrate that there are numerous alternative models to that suggested by IslamRaja, some of which are discussed within Coltrin. Some of the alternative models proposed for the silicon dioxide deposition from TEOS, such as the one set forth by Coltrin at page 257, Table 1 and accompanying text, propose numerous gas phase and surface reactions, each of which

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can be modeled as reversible, including the product binding reaction (see Table 1, reaction S8). In addition, applicant notes that multiple reactions within the Coltrin model could potentially be affected by the addition of water or peroxide (see Table 1, reactions G2, G4, S7 and S8). Again, Coltrin's proposed model is one of many yet to be proven models. However, because there is no single proven reaction mechanism or single accepted model, it is impossible to state with certainty that there is no reverse reaction or that no equilibrium can exist. Accordingly, applicant respectfully requests withdrawal of the § 112 lack of enablement rejection of claims 48 and 52.

Claims 39-41, 44-46, 47 and 48-52 stand rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor, at the time the application was filed, had possession of the claimed invention. The Examiner states that the recitation "comprising at least about 5% by volume" of gaseous oxide of a hydrogen has no basis because the specification at page 10 and page 12 sets upper limits for the volume of gaseous oxide of hydrogen. Without admission as to the propriety of the Examiner's rejection, applicant has amended independent claims 39, 47 and 48 to recite a gaseous oxide of hydrogen comprising from about 5% to about 50% by volume of the material fed into the reactor. Claim 40 has been cancelled. Accordingly, applicant respectfully requests withdrawal of the § 112 rejection of independent claims 39, 47 and 48 and the corresponding dependent claims 41, 44-46 and 49-52 in the Examiner's next action.

Claims 39, 41 and 44-52 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Sukharov, U.S. Patent No. 5,710,079. An obviousness rejection requires 1) that there be a suggestion or motivation to modify the reference or to combine reference teachings, 2) that there be a reasonable expectation of success and 3) the prior

art reference must teach or suggest all the claim limitations. Claims 39, 41 and 44-52 are allowable over Sukharev for at least the reason that Sukharev fails to teach or suggest each and every feature in any of those claims.

As amended, independent claim 39 recites feeding at least one of H_2O or H_2O_2 into a reactor, the at least one of H_2O or H_2O_2 comprising from about 5% to about 50% of the material fed into the reactor and being added to the reactor in an absence of an external ozone source. The amendment to claim 39 is supported by the specification at, for example, page 9, lines 3-23; page 10, lines 3-15; page 11, lines 11-17 and page 11, line 22 through page 12, line 10. Sukharev discloses providing an organometallic precursor together with ozone into a CVD reactor and exposing the ozone to ultraviolet radiation (col. 3, lines 26-32; and col. 7, lines 54-56). Sukharev fails to disclose or suggest the recited adding from about 5% to about 50% by volume of at least one of H_2O or H_2O_2 to a reactor in an absence of an external ozone source. Independent claim 39 is therefore not rendered obvious by Sukharev and is allowable over this reference.

Dependent claim 40 has been cancelled. Dependent claim 45 has been amended to recite a hot-wall reactor comprising an internal pressure from about 100 mTorr to about 3 Torr. The amendment to claim 45 is supported by the specification at, for example, page 7, line 23 through page 8, line 3. Dependent claim 46 has been amended to recite a cold-wall reactor comprising an internal pressure from about 10 Torr to about 80 Torr. The amendment to claim 46 is supported by the specification at, for example, page 11, lines 11-13. Dependent claims 41 and 44-46 are allowable over Sukharev for at least the reason that they depend from allowable base claim 39.

Independent claim 47 has been amended to recite feeding an organic silicon precursor and an additional quantity of a gaseous oxide of hydrogen into a reactor from separate feed streams in an absence of an external source of ozone. Independent claim

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47 is allowable for reasons similar to those discussed above with respect to independent claim 39.

Dependent claim 50, as amended, recites a hot-wall reactor comprising an internal pressure from about 100 mTorr to about 3 Torr. The amendment to claim 50 is supported by the specification at, for example, page 7, line 23 through page 8, line 3. Dependent claim 51, as amended, recites a cold-wall reactor comprising an internal pressure from about 10 Torr to about 80 Torr. The amendment to claim 51 is supported by the specification at, for example, page 11, lines 11-13. Dependent claims 49-51 are allowable over Sukharev for at least the reason that they depend from allowable base claim 47.

As amended, independent claim 48 recites placing a substrate within a hot-wall, low-pressure chemical vapor deposition reactor comprising an internal pressure from about 100 mTorr to about 3 Torr. The amendment of claim 48 is supported by the specification at, for example, page 7, line 23 through page 8, line 3. Sukharev discloses a deposition process carried out at atmospheric pressure (col 3, lines 63-65). Sukharev fails to teach or suggest the recited hot-wall, low-pressure CVD reactor comprising an internal pressure from about 100 mTorr to about 3 Torr. Independent claim 48 is therefore allowable over Sukharev.

Dependent claim 52 is allowable over Sukharev for at least the reason that it depends from allowable base claim 48.

Claims 39, 41 and 44-52 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Sukharev in view of Wolf. As discussed above, Sukharev fails to disclose or suggest the claims 39 and 47 recited feeding a gaseous oxide of hydrogen into a low pressure chemical vapor deposition reactor in an absence of an external ozone source. Wolf discloses depositing silicon dioxide using low pressure chemical vapor deposition reactors (page 169). Wolf does not disclose or suggest the feeding a gaseous oxide of hydrogen into a low pressure chemical vapor deposition reactor in an absence of

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an external source of ozone. As combined, Sukharev and Wolf fail to disclose or suggest the claim 39 and claim 47 recited feeding a quantity of gaseous oxide of hydrogen into a low pressure CVD reactor in an absence of an external source of ozone. Independent claims 39 and 47 are therefore allowable over the combination of Sukharev and Wolf.

Dependent claims 41, 44-46 and 49-51 are allowable over the combination of Sukharev and Wolf for at least the reason that they depend from corresponding base claims 39 and 47.

As discussed above, Sukharev fails to disclose or suggest the claim 48 recited placing a substrate within a hot-wall, low-pressure CVD reactor comprising an internal pressure from about 100 mTorr to about 3 Torr. Independent claim 48 further recites feeding a gaseous oxide of hydrogen into the hot-wall, low-pressure CVD reactor. Wolf does not disclose or suggest the recited feeding a gaseous oxide of hydrogen into a hot-wall, low-pressure CVD reactor comprising an internal pressure from about 100 mTorr to about 3 Torr. The combination of Sukharev and Wolf fails to disclose or suggest the recited feeding of a gaseous oxide of hydrogen into a hot-wall, low-pressure CVD reactor comprising an internal pressure of from about 100 mTorr to about 3 Torr. Independent claim 48 is therefore not rendered obvious by Sukharev as combined with Wolf and is allowable over this combination of references.

Dependent claim 52 is allowable over the combination of Sukharev and Wolf for at least the reason that it depends from allowable base claim 48.

For the reasons discussed above, claims 39, 41, and 44-52 are allowable. Accordingly, applicant respectfully requests formal allowance of claims 39, 41, and 44-52 in the Examiner's next action.

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Respectfully submitted,

Dated: *March 7, 2002* By: *Jennifer J. Taylor*
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Reg. No. 18,711

Enclosures: Article "Chemical Kinetics in Chemical Vapor Deposition: Growth of Silicon Dioxide from Tetraethoxysilane (TEOS), Coltin et al. Thin Solid Films 365 (2000) 251-263.

Application Serial No. 09/212,726
Filing Date .... December 15, 1998
Inventor .... Schuegraf
Assignee .... Micron Technology, Inc.
Group Art Unit 2813
Examiner .... Kielin, E.
Attorney's Docket No. MI22-1098
Title: Semiconductor Processing Methods of Chemical Vapor Depositing SiO2 on a Substrate

VERSION WITH MARKINGS TO SHOW CHANGES MADE ACCOMPANYING RCE

In the Claims

The claims have been amended as follows. Underlines indicate insertions and ~~strikeouts~~ indicate deletions.

39. (Amended) A semiconductor processing method of depositing SiO_2 on a substrate within a low pressure chemical vapor deposition reactor comprising feeding at least one of H_2O and H_2O_2 into the low pressure chemical vapor deposition reactor while feeding an organic silicon precursor, ~~wherein~~ the at least one of H_2O and H_2O_2 ~~is~~ being fed into the reactor separately from the organic silicon precursor, and comprising from ~~comprises at least~~ about 5% to about 50% by volume of the material fed into the reactor, the at least one of H_2O and H_2O_2 being added to the reactor in an absence of an external ozone source and being ~~and under conditions which are~~ effective to reduce formation of undesired reaction intermediates of the organic silicon precursor which form at higher topographical elevations on the substrate than would otherwise occur without the feeding of the at least one of H_2O and H_2O_2 into the reactor under otherwise identical depositing conditions.

40. (Cancelled) ~~The semiconductor processing method of claim 39, wherein the at least one of H_2O and H_2O_2 comprises less than about 50% by volume of material injected into the reactor~~.

45. (Amended) The semiconductor processing method of Claim 39, wherein the chemical vapor deposition reactor is a hot wall reactor <u>comprising an internal pressure from about 100 mTorr to about 3 Torr</u>.

46. (Amended) The semiconductor processing method of Claim 39, wherein the chemical vapor deposition reactor is a cold wall reactor <u>comprising an internal pressure from about 10 Torr to about 80 Torr</u>.

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47. (Amended) A semiconductor processing method of chemical vapor depositing SiO_2 on a substrate comprising:

placing a substrate within a low pressure chemical vapor deposition reactor;

feeding an organic silicon precursor into the low pressure chemical vapor deposition reactor having the substrate positioned therein under conditions effective to decompose the precursor into SiO_2 which deposits on the substrate and into a gaseous oxide of hydrogen; and

feeding an additional quantity of the gaseous oxide of hydrogen into the low pressure chemical vapor deposition reactor while feeding the organic silicon precursor into the reactor, the additional quantity comprising from ~~at least~~ about 5% to about 50% by volume of the material fed into the reactor, wherein the organic silicon precursor and the additional quantity of the gaseous oxide of hydrogen are fed into the reactor from separate feed streams in an absence of an external ozone source, the additional quantity of the gaseous oxide of hydrogen being and under conditions which are effective to reduce formation of undesired reaction intermediates of the organic silicon precursor which form at higher topographical elevations on the substrate than would otherwise occur without the feeding of the additional quantity of the gaseous oxide of hydrogen ~~at least one of H_2O and H_2O_2~~ into the reactor under otherwise identical depositing conditions.

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48. (Amended) A semiconductor processing method of chemical vapor depositing SiO_2 on a substrate comprising:

placing a substrate within a hot-wall, low-pressure chemical vapor deposition reactor comprising an internal pressure from about 100 mTorr to about 3 Torr;

feeding an organic silicon precursor into the hot wall, low-pressure chemical vapor deposition reactor having the substrate positioned therein;

feeding an additional quantity of the gaseous oxide of hydrogen into the hot wall, low pressure chemical vapor deposition reactor while feeding the organic silicon precursor into the reactor, wherein the organic silicon precursor and the additional quantity of the gaseous oxide of hydrogen are fed into the reactor from separate feed streams, the additional quantity comprising from at least about 5% to about 50% by volume of the material fed into the reactor; and

providing conditions effective to decompose the precursor into SiO_2 at a theoretical decomposition rate, the additional quantity of gaseous oxide of hydrogen reducing ~~and effective to cause the additional quantity of gaseous oxide of hydrogen to reduce~~ the theoretical decomposition rate to a lower actual decomposition rate, the reducing a function of at least some of the additional quantity of gaseous oxide of hydrogen reducing formation of undesired reaction intermediates of the organic silicon precursor which form at higher topographical elevations on the substrate than would otherwise occur without the feeding of the at least one of H_2O and H_2O_2 into the hot-wall, low-pressure chemical vapor deposition reactor under otherwise identical depositing conditions.

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50. (Amended) The semiconductor processing method of Claim 47, wherein the chemical vapor deposition reactor is a hot wall reactor comprising an internal pressure from about 100 mTorr to about 3 Torr.

51. (Amended) The semiconductor processing method of Claim 47, wherein the chemical vapor deposition reactor is a cold wall reactor comprising an internal pressure from about 10 Torr to about 80 Torr.

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